

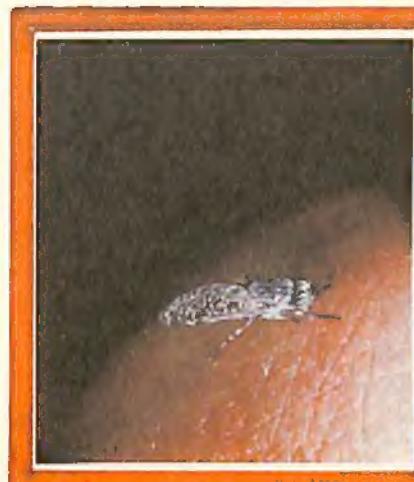
VITALI TANASYCHUK

HOW MANY EYES DOES A DRAGONFLY HAVE?



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HORSEFLY



RED ADMIRAL



LOCUST

Y

You have often walked in the woods on a warm summer day, I'm sure. The clouds drift by in the blue sky like giant sails, tall pines with bark of reddish-gold sway in the breeze, and flowers look like spots of flame on the edge of the woods. You think you are the only one around.

Are you really? Thousands of eyes are watching your every movement from under the leaves and the grass and even from the sky.

A swallow darts across the sky. It sees you but pays no attention. It fears not creatures that walk but creatures that fly. You can do it no harm.

A locust sits in the grass. It sees you and gets frightened, so it hops and flies off, crackling its wings. The locust has many enemies. It is afraid you may suddenly eat it.

But if a horsefly spots you with its rainbow-coloured eyes, it will not make off. It will try to pierce your skin with its sharp stinger. You are prey for the horsefly.

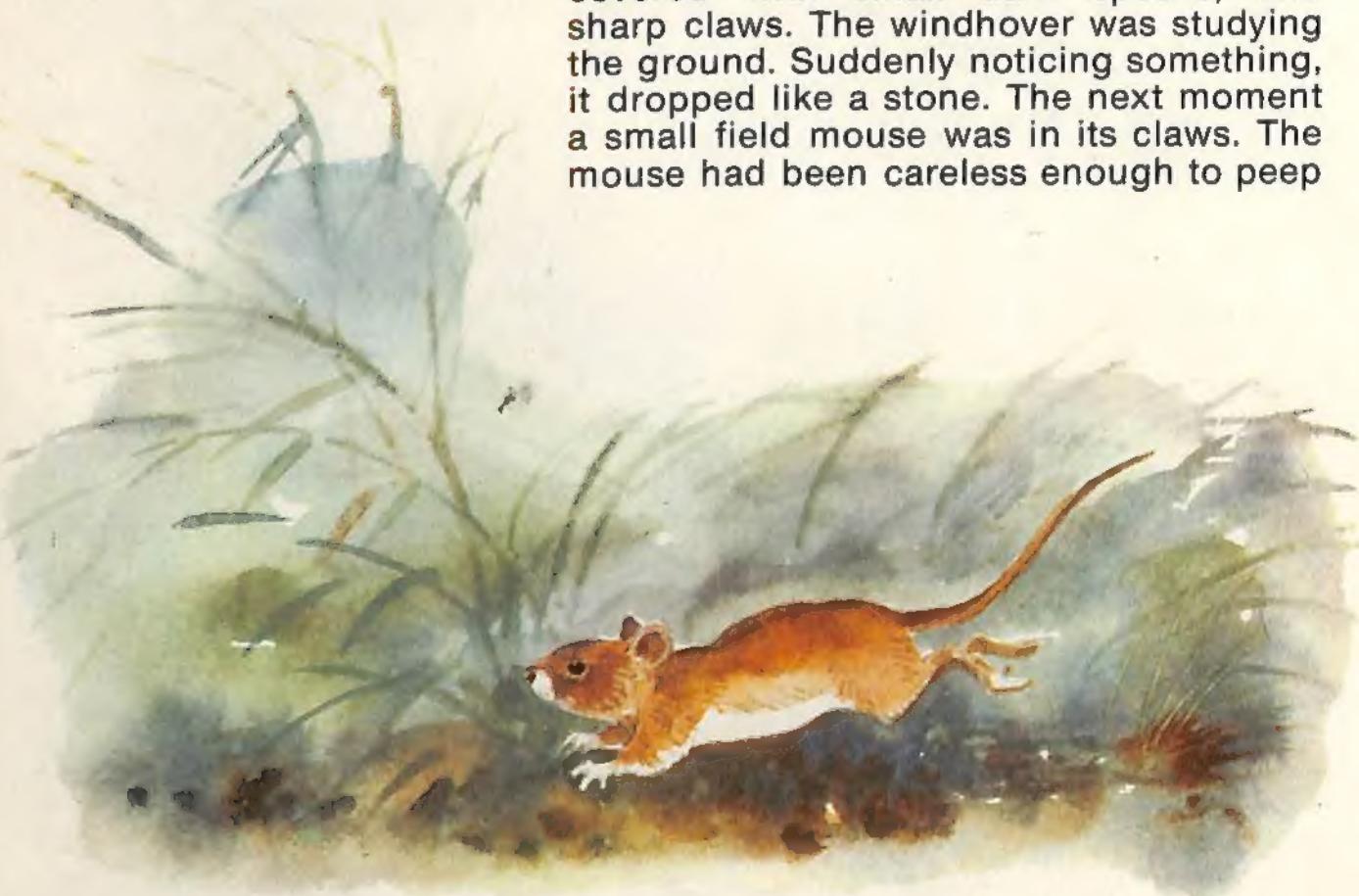
Many different creatures inhabit the earth, and each lives in its own way and sees in its own way. Let us take a closer look at some of these creatures and see what eyes they have.

EYES LIKE FIELD GLASSES

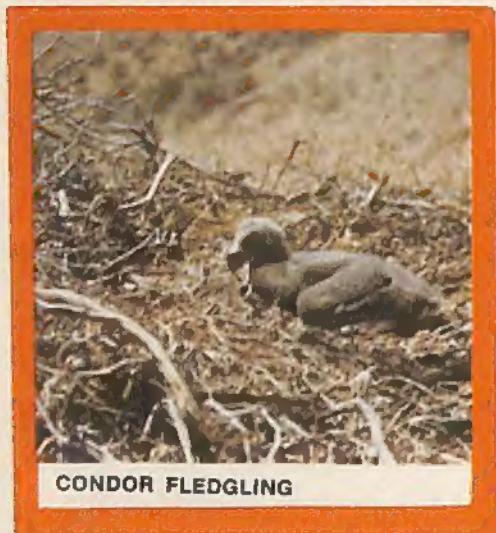


I was walking in a meadow when I noticed a bird high in the sky fluttering its wings and hovering over one spot. "What could that be?" I wondered.

I put my field glasses to my eyes and saw a small windhover with a short and curved beak like an eagle's, a rusty breast covered with small dark specks, and sharp claws. The windhover was studying the ground. Suddenly noticing something, it dropped like a stone. The next moment a small field mouse was in its claws. The mouse had been careless enough to peep







out of its hole. But how could the bird have seen its tiny prey from so high up?

You see, many birds of prey—eagles, hawks, and falcons—have remarkable eyesight. They can see from far above every bush and hole as clearly as a person using field glasses. This is how the windhover caught sight of the mouse scores of metres away.

The giant condor which feeds on dead animals spots its prey from far above. It flies so high that it is almost invisible from the ground, but it sees everything happening below.



CONDOR



SHORT-SIGHTED CREATURES



SPIDER



POND SNAIL



GRAPE SNAIL

You can see many interesting things if you lie still in the grass and watch the life around you through a magnifying glass. A blade of grass looks like a tree and an ant like a terrifying monster in shining armour. But if you look into the distance through the glass, you will see nothing but a blur.

In this way I once observed a huge hairy spider hiding behind a stone and looking around with all its eyes, and there are no less than eight of them. Six small eyes were pointed in all directions, while two huge eyes like automobile headlights looked right at me. In a moment the spider would jump at me!

But then I lowered the glass and saw that the spider was really very small, smaller than a pea. And it was looking not at me but at a fly sitting beside me. Suddenly the spider squatted and jumped at the fly. The poor fly didn't even have time to budge.

Such spiders never spin a web. They get their prey by jumping on it from ambush. That is why they are called hoppers. These spiders see well only over a distance of about ten centimetres. Everything farther away is in a mist.



Turning my head a little, I saw a snail crawling in the grass. "Where are its eyes?" I wondered. The snail has four tiny prongs on its head, just like horns. The lower two are feelers, while the upper two have eyes at their tips. If a snail wants to look at a leaf, it bends down its upper horns and examines the leaf, using its eyes as magnifying glasses. These eyes are very simple and very short-sighted, but the snail can see everything it needs to. Just bring your hand close to these eyes and the snail will immediately pull in its horns and hide in its shell.

CREATURES THAT SEE IN THE DARK



DOMESTIC CAT



OWL

When do you see best, in the daytime or at night? In the daytime, of course. The sun is out and it is light.

At night, even when the moon is out and the stars are shining, people see poorly. But there are creatures that would rather sleep in the daytime and hunt for food at night.

Take the domestic cat. There it is lying on the couch and purring. You, of course, have long marvelled at the cat's green eyes. Do you know why they gleam in the dark?

Inside the cat's eyes there are many silvery crystals, just like tiny mirrors. These mirrors collect the light that finds its way into the eyes and magnify it. That is why the cat can see at night.

But daylight is too bright for the cat's eyes. They have to protect themselves.

Take a look at the cat's eyes in broad daylight. You will see that the pupils of the eyes are narrow slits. They let in very little light, but it is enough for the cat to see because the tiny mirrors make the



WILDCAT

light stronger. The cat sees well in the daytime even with such slits of eyes.

In the evening or at night the pupils become large and round. They gather all the light to the very last ray, and the mirrors do their work efficiently. This is why a cat can see everything in the dark, too.



Not only cats have such eyes. One evening, when I was in a southern town, I found myself in an abandoned house. I saw a strange lizard with huge eyes, which was running about the walls of the semi-dark room, catching flies. This was a gecko.

I decided to take a picture of it. Trying to make no noise, I crept up to the lizard and clicked the camera. For a moment a bright light, like a flash of lightning, illuminated the gecko.

And what did I see? A second ago the gecko had eyes with round black pupils, and now, in the light produced by the flash, the pupils turned into thin, fantastically shaped slits. This means that the gecko protects its eyes from bright light in the same way as the cat. It too, after all, does its hunting at night.

Even some types of sharks have eyes with pupils that change their shape. When the shark is deep underwater, where there is always twilight, the pupils are round. But when the shark comes to the surface, where there is more light, the pupils become narrow, just as they do in the eyes of cats and geckos.



CREATURES THAT SEE IN BOTH WATER AND AIR



WHIRLIGIG BEETLE



FOUR-EYED FISH

I'm sure that when you are swimming in a river or sea in summer, you open your eyes in the water. If you look around underwater, you'll see hazy green and brown patches of light instead of seaweed and rocks. This is because our eyes can see well only in air. Fishes, on the contrary, see well only in water. But how about creatures that live on the water's surface?

A lot of tiny brilliant whirligig beetles are circling on the surface of the water. If the beetles spot a fish stealing up on them, they jump out of the water. If they notice a bird getting interested in them, they dive into the water. How is it that they are able to see equally well in water and in air?

A remarkable thing has happened to these beetles. Each eye has divided itself into two halves. The lower half is under the water and on the lookout for fish, while the upper half is above the water and on the lookout for birds. Actually the beetle has four eyes.

In the waters of South America there is even a fish with four eyes. This fish



swims close to the surface of the water and needs four eyes, a pair for looking underwater and another pair for looking above the water. And so the eyes became "double-deckers." The upper "deck" is used above the water and the lower below the water.

WHAT DOES A FROG SEE?

FROG



SAND LIZARD

A frog may sit motionless on the bank of a pond all day long. Do you think it is lazy? Not at all. The frog is very busy. It is on the lookout for prey. If a common fly or a dragonfly comes down on the damp ground, the goggle-eyed hunter will immediately smack the insect with its long tongue. It then swallows its prey and again waits patiently for its food.

Once I was watching such a frog and decided to help it. I caught a horsefly and threw it in front of the frog. The frog paid no attention to the fly as if it were a pebble.

I then threw another horsefly, and again there was no reaction. "What is the matter?" I wondered. "The frog was catching the same flies. Why didn't it like my gifts?"

"O. K.," thought I. "I will trick you." I took a piece of bright-coloured cloth, tied it to a thread, and pulled the cloth in front of the frog. The frog immediately snatched the cloth and got caught on the thread in the way a fish gets caught on a hook. I had great trouble freeing the frog.



So why did the frog ignore the horseflies that I threw to it but snatched up the piece of cloth? The answer is simple. For a frog food is only what is moving. It simply does not see an object that is not moving. If a rag is moving, it is food and it must be caught.

A great many small hunters—lizards, insects, and small animals—notice their prey only when it moves. So how can the prey save itself? Obviously, by not moving. When you move a hand toward a beetle, the beetle pulls in its legs and makes believe it is dead. You are sure that it is not, but the beetle's real enemy would not notice it.

WHO NEEDS NO EYES?



EYELESS BEETLE



OLM



TERMITE

Can it be that somebody may have no need for eyes? You would think that life is impossible without eyes.

But this is not so. I have been underground in caves many times. But if in this total darkness I switch on a flashlight to see my way, I may suddenly spot a beetle on the wall. How does it find its way in the dark? And when I look more closely at the beetle, I see that it has no eyes at all. All their lives do these cave dwellers feel their way around. And they are not the only ones. Small shellfish and fish in underground lakes and rivers are also blind. Where it is always dark, there is no need for eyes.

A small animal known as the mole rat lives on the Russian plains. It has no eyes, only folds of skin where eyes should be. It never leaves its endless underground tunnels to go out into the sunshine. The mole rat eats roots of some plants and vegetables, and green grass. But grass grows above ground. How does the mole rat get to it? The cunning animal feels the roots of the grass underground and pulls the grass into its hole.



MOLE RAT

In hot places, say, Soviet Central Asia, there are eyeless insects which have a remarkable way of life.

Imagine a house, a sturdy house made of logs. It may stand for a year or two or even twenty years. And then, all of a sudden, if someone leans against it, the walls cave in. What is the matter? If you look inside the walls of such a house, you will find them hollow. The logs have been eaten away by yellowish-white insects that swarm inside. The wood has been reduced to a powder. The insects are termites, or white ants, as they are sometimes called. They are very greedy and absolutely blind. Termites have no eyes, only black spots in their place.

WHO CAN SEE ALL AROUND THEMSELVES?



What do you do when you want to look behind you? You turn around, of course. People, dogs, and even snakes do this. But an owl does not have to because its head turns as if it were on hinges. No matter from what direction you approach the owl, from behind or from the side, it will turn its head towards you without moving its body

Well, and how do chameleons see what is happening around them? Chameleons are related to lizards. They are really remarkable creatures, for they can change their colouring. When a chameleon sits among leaves, it is green, and when it crawls onto a stone, it becomes as grey as the stone. Also, it has an unusual tongue, which has a large sticky tip and is nearly as long as the chameleon itself. If a grasshopper or butterfly comes down nearby, the



chameleon shoots out its tongue. Slap! And the prey has stuck to it. Snap! The tongue together with the insect is back in the mouth.

But what is most surprising about the chameleon is its eyes. Not only because they are so bulging and covered with scales but mainly



PRAYING MANTIS



CHAMELEON FLY



STALK-EYED FLY

because of how they see. The eyes of human beings, animals, birds, and lizards always point in the same direction. But each eye of a chameleon works independently. One may look down while the other looks back or sideways. Now isn't that convenient!

Many insects, too, can see what is happening around them without moving their head. A praying mantis once lived on a potted plant on my window-sill. It caught flies. It would sit on a stalk with its front legs drawn up to its breast, as if in prayer. This is why it came to be called a praying mantis. But if you take a close look at those legs, you will see big hooks and spikes on them. You will understand then that this is a pirate, not a goody-goody.

It sits perfectly still, as green as the leaves around it, so that it cannot be seen, and looks in all directions, up, down, and behind, without even turning its head. If it sees anything interesting, it bends its head, as a person does when watching something closely. And then it grabs its prey!

But how can a praying mantis see in all directions at once? Take a look at my photograph of the creature. See the eyes? They are big and bulging, like two halves of an apple. They are made up of many tiny eyes pressed together. Each tiny eye sees only a very small part of a leaf or stalk. But thousands of tiny eyes can see everything around. What they see is like a mosaic of tiny separate parts. The eyes of a praying mantis are round,



and the tiny eyes look in all directions, so that the praying mantis sees at one and the same time everything happening around it: below, above, in front, and behind.

HOW MANY EYES DOES A DRAGONFLY HAVE?



ANT



FLY



DRAGONFLY

Like the praying mantis, almost all insects have eyes that consist of many tiny eyes. And the more they have of these tiny eyes the better they see.

Ants, for example, do not see very well because their eyes consist of only several hundred tiny eyes. But ants have an acute sense of smell, and they use it to find their way to their anthill.

Flies have many more little eyes. Each eye contains about four thousand of them, so that flies see fairly well. If you drop jam on a table, flies will come very fast. And, you know, flies take great care of their eyes. They rub them with their feet to take off every bit of dust.

But the champion in eyesight among insects is, probably, the dragonfly. In each eye of a dragonfly there may be as many as twenty-eight thousand little eyes. But not only this makes the eyes of the dragonfly so exceptional.

Do you remember I told you about the whirligig beetle, each eye of which is



divided into two halves? Well, the upper and lower parts of a dragonfly's eye are different, too. The upper half has fewer little eyes and they are bigger than those in the lower half, but the lower half has many more of them, and they are smaller.

Just look how a dragonfly hunts for its prey! It flies in zigzags above a meadow, up and down, to and fro, catching flies and mosquitos. If a fly is above the dragonfly, it can easily be seen because the sky is light and the fly dark. If a dark object is moving

Vitall Taneasychuk

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Illustrated by Andrei Koleinikov

Photographs by Vitall Taneasychuk

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